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SCIENCE

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FRIDAY, JUNE 24, 1898.

MODELS OF EXTINCT VERTEBRATES.*

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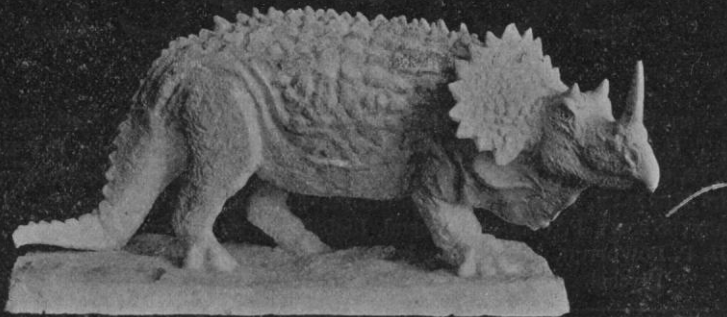
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THERE are certain obligations resting upon the curators of metropolitan museums from which curators of university museums should enjoy a grateful immunity. These mainly involve the difficult undertaking of arousing interest and spreading accurate information among a very large class of inquisitive but wholly uninformed people. If these obligations are unfulfilled the metropolitan museum fails in its purpose and deserves the withdrawal of public support.

With this general idea in mind, members of the Department of Vertebrate Paleontology at the American Museum have been making a special study of all the legitimate methods of attracting the attention and interest of visitors. Among these methods are the series of water-color restorations of extinct vertebrates, executed by the animal painter, Mr. Charles Knight, with the aid of various scientific suggestions and criticisms. The preparation of these drawings involves a far more careful preliminary study than would generally be supposed. The artist begins by making a number of models in wax, based upon the actual proportions and muscular indications of the skeleton, and by

* Catalogue of Casts, Models, Photographs and Restorations of Fossil Vertebrates, issued by the Department of Vertebrate Paleontology, American Museum of Natural History, April, 1898.

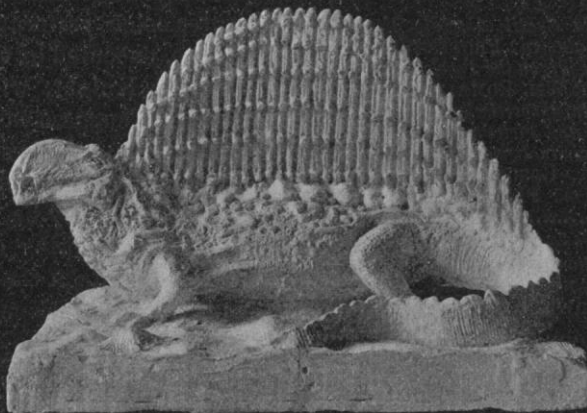
MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.



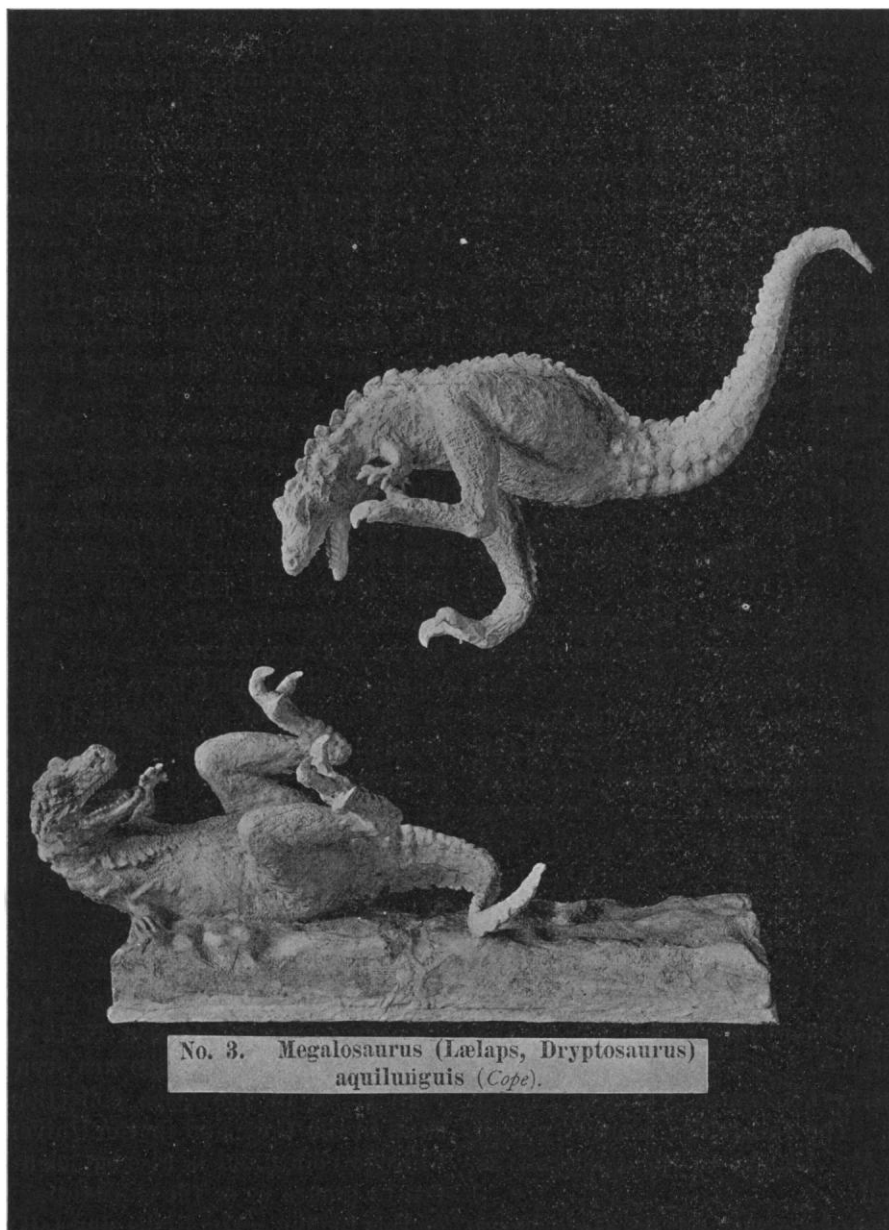
No. 1. *Agathaumas sphenocerus* Cope.



No. 2. *Hadrosaurus mirabilis* Leidy.



No. 4. *Naosaurus claviger* Cope.



a series of preliminary anatomical studies representing different attitudes and feeding habits. Thus in the restoration of an extinct animal the proportions and positions of all the joints and angles of the feet and limbs may be made true to life. The lips, nos-

trils and gape of the mouth are determined by comparison of the length of the nasals, size of the anterior nares, character and position of the teeth, with similar parts in the most nearly related forms. The eyes are carefully located and proportioned. Up

to this point the animal may be considered a fairly correct representation of the original. On the other hand, the shape of the ears, the color and epidermic characters are largely imaginative, except in so far as they are suggested by relationship to modern allies, as in the case of horses, tapirs, rhinoceroses and other forms.

Out of the necessity of giving the restorations a complete and natural artistic relief, the wax models have been made with increasing care, and it finally occurred to the writer that, with a little more elaboration, the models themselves might be made well worthy of preservation in plaster form, first finished in wax and then cast from a carefully prepared plaster model, as represented in the accompanying photographs.

The frilled Dinosaur, *Agathaumas sphenocerus*, Cope, is based upon a prior restoration, published by Professor O. C. Marsh, of his *Triceratops prorsus*, this genus and species being distinguished from *Triceratops* by the large anterior median horn and the small posterior paired horns. As well known from Professor Marsh's descriptions and restorations, these Dinosaurs were greater-bivorous quadrupeds, with fore and hind limbs more symmetrically developed than in any other members of this sub-class, the total length of the skeleton being about 25 feet. In addition to the powerful horns the skull is protected by a great bony collar or frill, which is surrounded by heavily barbed tubercles. The tubercular character also given by Mr. Knight to the epidermis is conjectural.

The form of the second type, *Hadrosaurus mirabilis*, Leidy, is quite as fully known, as it rests upon the remarkably complete skeleton in the Cope collection, found in 1882 by Dr. J. L. Wortman in the Laramie Cretaceous, and described by Professor Cope under the generic name *Diclonius*. This animal was thirty-eight feet in length, with

a long neck, flattened duck-like bill, weak teeth, small fore limbs and heavy hind limbs, the body terminating in an elongated tail. It was probably of littoral habits, feeding on soft water-plants or small mud-loving organisms.

The third type, *Megalosaurus aquilunguis*, Cope (Laelaps), is the most extreme example of a highly conjectural restoration. It embodies the original ideas of Cope upon this subject, that these carnivorous Dinosaurs were capable of leaping through the air. The restoration is based upon the fragmentary skeletons in the Cope collection, and upon Professor Marsh's restoration of the allied form, *Ceratosaurus*. The skeleton was light, partly pneumatic. This species was about seven feet in length of trunk and neck, and had eight feet of tail. The disproportionately long hindlimbs and heavy tail remind one of the Kangaroo, which animal it may have resembled, both in its method of progression by leaps instead of by walking or pacing and in using its powerful hind feet, armed with heavy claws, in attacking its enemies.

A most picturesque form is the *Naosaurus claviger*, Cope, which, although of the most extreme appearance, is probably nearer the truth than any one of the foregoing models. The enormous spines upon the back are not in the least exaggerated, since the spines of *Naosaurus* collected by Dr. E. C. Case for the University of Chicago are even longer than those in the Cope collection. The skull in the Cope and in the University of Chicago collections is also sufficiently perfect to assure us of the substantial fidelity of this region. The limbs and tail are lizard-like. The different species of *Naosaurus* reached from three to ten feet in length. The precise function of the extraordinary, rigid fin on the back is not known. It was humorously suggested by Cope that in *N. claviger*, in which the dorsal spines present a series of cross-bars, the fin may have been

used as a sail; it was quite as probably ornamental as protective. This animal belongs to the primitive reptilian order, Pelycosauria of Cope, but it represented a highly specialized side-branch related to the Rhynchocephalia or Proganosauria, as shown by Baur and Case.

Interest in the above series of four is enhanced by the fact that Professor Cope,

and Elk, so far as proportions of the body and the shape of the head are concerned.

Other models are in preparation, and the series of water-color restorations, which now numbers nineteen, is progressing as fast as the complete skeletons are procured and prepared, serving as a basis for anatomical study.

HENRY F. OSBORN.



FIG. 1.—Powell County Natural Bridge.

shortly before his death, gave Mr. Knight the benefit of many criticisms and ingenious suggestions.

The latest of this model series is taken from the remarkable skeleton of *Cervalces americanus*, in the Princeton Geological Museum. It is upon a larger scale than the preceding, and represents the animal as Scott has described it, namely, intermediate in form between the Moose

NATURAL ARCHES OF KENTUCKY.

ALONG the western margin of the Eastern Coal Field in Kentucky are a number of 'Natural Bridges,' which it seems to me cannot be explained in any of the ways yet suggested. They have not been formed by the falling in of the roofs of underground streams, by wind erosion, or yet again in the manner presented by the contribution on this subject in the May 20th number of